PROC. ENTOMOL. SOC. WASH.
84(3), 1982, pp. 521–528

A DESCRIPTION OF THE LARVA OF *DIXELLA NOVA* (WALKER) (DIPTERA:DIXIDAE)[1]

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Abstract.—The mature fourth instar of *Dixella nova* (Walker) is described and illustrated. Terms applied to larval dixid structures by authors of earlier descriptions are synonymized with those used in this paper.

All 44 species of Dixidae known to occur in the Nearctic Region have been described in the imaginal stage (Peters and Cook, 1966; Peters and Barbosa, 1970; Peters, 1981b). Knowledge of immature stages is sparse; only nine species have been described or illustrated (Johannsen, 1903, 1933; Nowell, 1951; Peters and Barbosa, 1970; Smith, 1928).

Adult dixids spend the majority of their time concealed in habitats along the edges of water dominated by overhanging vegetation. Hence, they are seldom taken by the general collector. However, adult males form swarms in late afternoon and evening along the water's edge and can be collected by wading along the shore.

Although a few immature dixids may be found in broad spectrum collections gathered for environmental impact statements, they are seldom collected except by specialized techniques. The pupa is attached to emergent vegetation or rocks above the waterline. The larva rests at the waterline with its body in an inverted U position so that only its head and caudal respiratory apparatus is in the meniscus. Thus, aquatic netting or use of dippers seldom catch immature dixids. However, larvae in lotic waters undergo diel drifting (Waters, 1962) and are caught by drift sampling techniques. Both lentic and lotic forms may be washed into an aquatic net from their positions on emergent objects and the water's edge. If the net is emptied into a white pan full of water, the larvae soon swim to the surface and may be picked out.

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[1] Research supported by project MS-27 of the Massachusetts Agricultural Experiment Station. Published with the aid of a grant from the Guy Chester Crampton Research Fund of the University of Massachusetts.

At present, the only way most larvae can be identified to species is by rearing to the adult stage and then identifying them. However, most specimens are preserved as they are caught and are thereby not identifiable to species except by comparison with the few published larval descriptions. Here too, a problem is encountered because of the diverse terminology used for the morphological structures employed in the specific descriptions.

The purpose of this paper is twofold. The first objective is to stabilize the terminology so that workers can use the previous larval descriptions with some confidence that the structures being compared between articles are the same. The second objective is to describe the mature larva of *Dixella nova* (Walker) and to illustrate the structures that are of value in comparing it to previously known larvae. The complete chaetotaxy is not presented here, but it will be covered in a future paper comparing all the known larval dixids from the Nearctic Region.

Description of the Mature Fourth Instar of *Dixella nova* (Walker)

Figs. 1, 2, 3

Length 2.8–3.4 mm ($N = 10$). Head and caudal respiratory apparatus medium brown, heavily sclerotized. Body cylindrical, predominantly slate gray, including thoracic segments and abdominal segment 8. Abdominal segments 1–7 countershaded, with venter lighter gray. Mesothorax with 2 paired subcircular non-pigmented areas, one on each pleural area with a second contiguous to it toward the venter. Metathorax with single non-pigmented subcircular area on each side, slightly smaller than those of mesothorax.

Head as in Fig. 3A. Eye posterior to and slightly below insertion of antenna, with heavy sclerotization of head capsule around dorsoanterior margin but very lightly sclerotized immediately below and behind eye, becoming heavily sclerotized just anterior to seta 10 (following system of Belkin et al., 1970). Seta 1 as long as mouth brushes but of greater diameter, moderately sinusoidal, blunt-ended. Seta 3 shorter than mouth brushes, flattened, pointed, widest in middle. Antenna with numerous pointed terminal sensilla. A very lightly sclerotized, pear-shaped sensillum located in depression bounded by ring of pointed terminal sensilla. This sensillum often destroyed in permanently mounted specimens (see insert in Fig. 3C).

Mandible as in Fig. 3A. Dorsal tooth between mandibular brush and seta 2. Mandibular brush tapering from long distal hair, shortest basally. Two prominent, heavily sclerotized ventral teeth, the distal one largest. A row of accessory teeth between inner ventral tooth and articulation. An elongate tuft of branched, slender hairs forms the mandibular sweeper, arising from basal edge of accessory tooth ridge, at 90° angle to row of accessory teeth

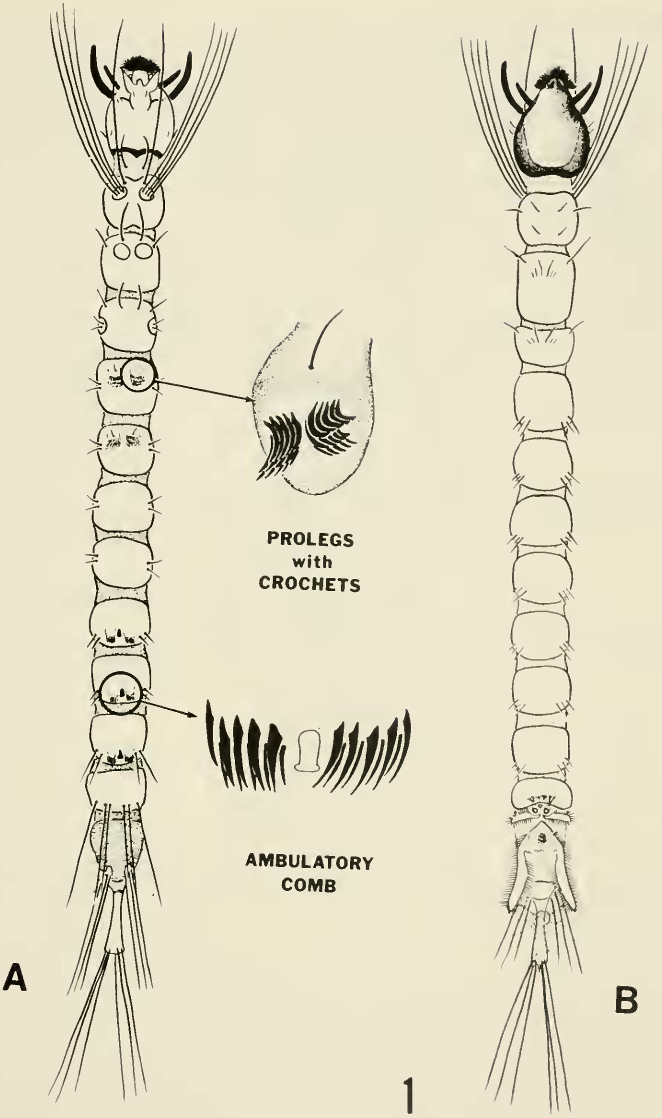

Fig. 1. Mature fourth-instar of *Dixella nova*. A, Ventral view. B, Dorsal view.

(see insert of Fig. 3A). Lateral seta prominent. Maxilla as in Fig. 3A. Palp antenniform.

Anterior ventral setae of prothorax prominent, extending beyond mouth brushes of head, arranged as 1-1-4-1-1-4-1-1. Each group of 4 share a common sclerotized base.

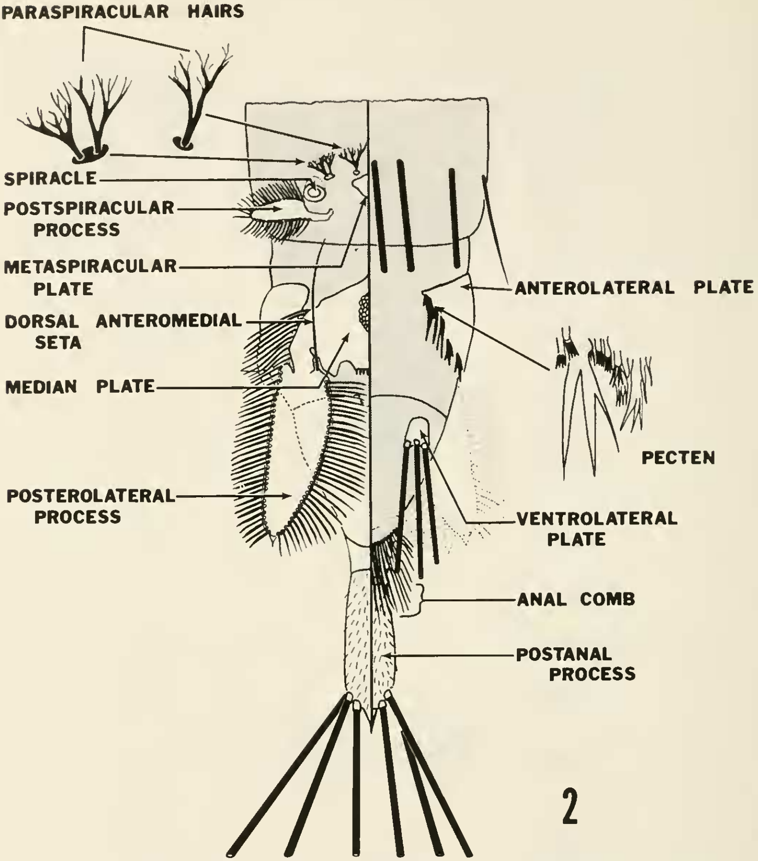

Fig. 2. Posterior abdominal structures of *Dixella nova* larva, slightly distended; left half dorsal, right half ventral.

Venter of abdominal segments 1 and 2 each with a pair of prolegs, tipped with anteriorly directed, uniordinal, triserial crochets (see insert, Fig. 1A). Base of prolegs slate gray, lighter distally. Segments 5–7 with ambulatory comb (see insert, Fig. 1A). Medial plate of comb subrectangular, posterolateral corners expanded. Spines of comb in 2 distinct rows, the smaller slightly appressed to surface of segment, the stouter row at a less acute angle to body surface.

Segment 8 simple ventrally, with row of 8 long stout setae. Dorsally a row of multiple-branched paraspiracular setae arise from 4 bases, lateral bases with 2 setae each, medial bases with 1 seta each. Metaspiracular plate located medially between spiracles; subtriangular, with apex directed pos-

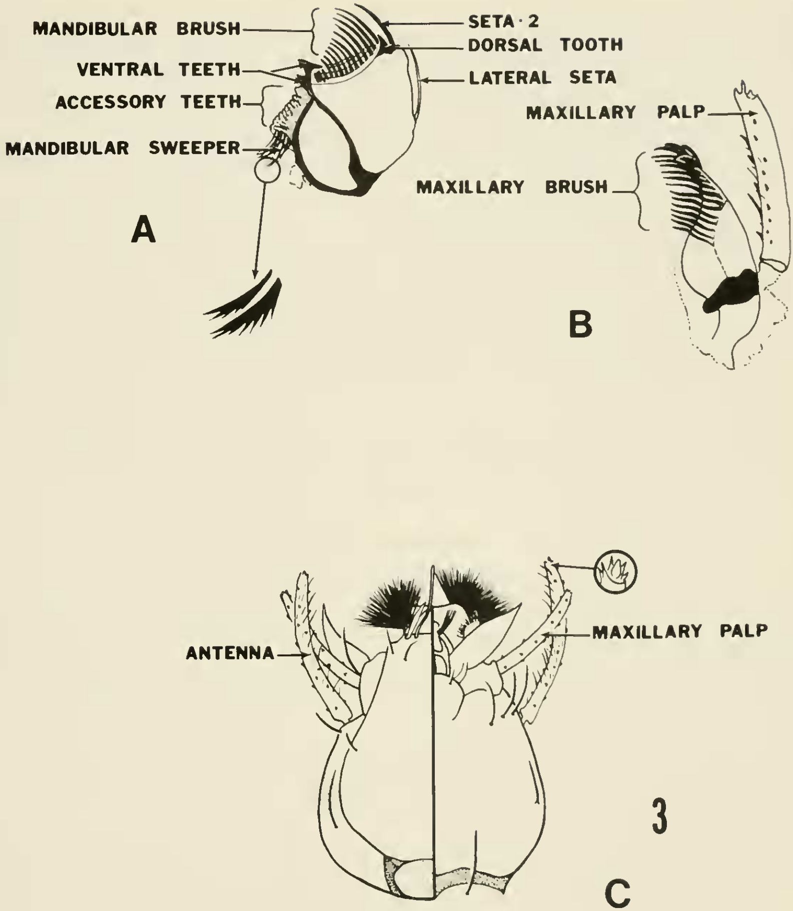

Fig. 3. *Dixella nova*. A, Left mandible, ventral view. B, Left maxilla, ventral view. C, Head, left half dorsal, right half ventral.

teriorly, center of plate elevated into a slight, blunt peak. Posterior to each spiracle is a laterally projecting, dorsoventrally flattened postspiracular process fringed with articulated setae.

Segment 9 with paired anterolateral plates bearing a complex pecten on the posterior margin; pecten of many small quadriradiate processes and a single large triradiate spine near the most ventral apex (see insert, Fig. 2). On dorsum a large median plate with slight sculpturing along mid-dorsal area in center of plate. Sculpturing formed by a contiguous group of elongate ovoids. Posterior medial margin of median plate with irregular row of very short complex, multiple-branched spines. Median plate extends into a pair of dorsoventrally flattened posterolateral processes fringed with articulated setae. Each process terminates posteriorly in a spine directly beneath the fringe. At base of each posterolateral process is a small dorsally projecting tubercle bearing a long, dorsal anteromedial seta.

Segment 10 conical; sclerotized dorsally; venter lightly sclerotized, bearing a pair of heavily sclerotized subtriangular ventrolateral plates, each with 3 very long posteriorly projecting setae. Just anterior to anus is a ventral anal comb of stout posteriorly projecting spines. Anterior to anal comb is an area of shorter delicate aculeae extending from one side of the segment ventrally to the opposite side. Behind anus, postanal process is entirely sclerotized with a sharp break in sclerotization at its narrowest diameter. Expanded and sparsely covered with moderately long microtrichia posterior to break. Caudal tip bears a posteriorly projecting spine on dorsum. Three pairs of long posteriorly projecting setae at caudal end. One pair projects dorsoposteriorly, another dorsolaterally, the 3rd posteroventrally.

Terminology

Terms previous authors have used for morphological structures in descriptions of larval dixids vary widely. The only attempts to standardize terminology have been by Belkin (1962, 1968) when he interpreted dixid morphology considering them to be a subfamily of the Culicidae. He synonymized much of dixid morphology with that used for anopheline mosquitoes.

The terminology I apply to the larval head and mouthparts follows that of Harbach and Knight (1980) for mosquitoes. However, I have not attempted to use culicid terminology for the caudal and respiratory complex of dixids since homologies are not certain. This is not surprising in light of the morphological (Rohdendorf, 1964) and cytogentic (Frizzi et al., 1966) evidence accumulating to support the separation of Dixidae from the Culicidae.

The following is a list of published names, by author, for those structures described and illustrated in the *D. nova* description above. Each author's name appears only if the structure was assigned a name in the listed reference.

Paraspiracular hairs or setae (=prespiracular hairs of Nowell, 1951, Smith, 1928).

Postspiracular process (=anterolateral lobes of Belkin, 1962, Contini, 1965; =spiracular valves, plates, or appendages of Edwards, 1932, Smith, 1928, Tonnoir, 1921–3, Brindle, 1963, Disney, 1975; =ear-shaped lobes of Nowell, 1951; =Seitenklappe of Martini, 1929).

Metaspiracular plate (=anterior median lobe of Belkin, 1962; =posterior median plate of Contini, 1965; =chordate chitinized area of Smith, 1928; =median plate of Peters, 1981a; =interspiracular disc of Disney, 1975).

Median plate (=median plate of Belkin, 1962, Contini, 1965; =basal plate of Brindle, 1963, Disney, 1975; =Mittelstück of Martini, 1929).

Posterolateral process (=posterolateral lobes of Belkin, 1962, Contini, 1965; =lateral plates of Tonnoir, 1921–3, Smith, 1928; =posterior articulated paddle of Nowell, 1951; =posterior appendage of Brindle, 1963; =ciliated lateral lobe of Johannsen, 1933; =large posterior valves of Edwards, 1932; =Seitenklappe of Hennig, 1950; =Hinterklappe of Martini, 1929; =posterior paddle of lateral plate of Disney, 1975).

Anterolateral plate with pecten (=pecten of Belkin, 1962, Johannsen, 1903, Martini, 1929, Smith, 1928; =pectinate comb of Nowell, 1951).

Ventrolateral plate (=Lateralplatte of Hennig, 1950; =Subventralplatte of Martini, 1929).

Anal comb (=supraanal spicules of Belkin, 1962; =guards for gill chamber of Smith, 1928).

Postanal process (=tail-process of Johannsen, 1933, Edwards, 1932; =caudal appendage of Tonnoir, 1921–3, Contini, 1965, Disney, 1975; =cap of Nowell, 1951; =Schwanzfortsatz of Martini, 1929, Hennig, 1950; =anal appendage of Brindle, 1963; =cylindrical caudal process of Belkin, 1962).

Ambulatory comb (=ambulacral plate of Nowell, 1951; =sclerotized pectinate plate of Johannsen, 1933; =locomotory plate of Contini, 1965; =spiney plate of Smith, 1928; =rows of spines of Belkin, 1962; =short, hook-like spines of Brindle, 1963; =plate set with rows of hooks of Edwards, 1932; =Fusstummel of Hennig, 1950; =ambulacral comb of Belkin, 1968; =ventral comb of Disney, 1975).

Prolegs with crochets (=pseudopods of Edwards, 1932, Contini, 1965; =pseudopods with spines, hooks, or claws of Nowell, 1951, Brindle, 1963, Smith, 1928; =prolegs of Johannsen, 1933; =prolegs with curved spines of Belkin, 1962; =Kriechwulste of Hennig, 1950).

LITERATURE CITED

Belkin, J. N. 1962. The Mosquitoes of the South Pacific. Univ. of Calif., Press, Berkeley. 2 vols. 608 pp., 412 pls.

———. 1968. Mosquito studies (Diptera, Culicidae) VII. The culicidae of New Zealand. Contrib. Am. Entomol. Inst. (Ann Arbor) 3: 1–182.

Belkin, J. N., S. J. Heinemann, and W. A. Page. 1970. Mosquito studies (Diptera, Culicidae) XXI. The culicidae of Jamaica. Contrib. Am. Entomol. Inst. (Ann Arbor) 6: 1–458.

Brindle, A. 1963. Taxonomic notes on the larvae of British Diptera. Entomologist (Lond.) 96: 237–243.

Contini, C. 1965. I Dixidae della Sardegna, Nuovi reperti e descrizione di *Palaeodixa frizzii* N. Gen. N. Sp. Mem. Soc. Entomol. Ital. 44: 95–108, 6 pls.

Disney, R. H. L. 1975. A key to the British dixidae. Freshw. Biol. Assoc. Sci. Publ. No. 31, 78 pp.

Edwards, F. W. 1932. Family Culicidae. *In* Wytsman, P., ed., Genera Insectorum Fasc. 194, pp. 8–15.

Frizzi, G., C. Contini, and M. Mameli. 1966. Ulteriori richerche citogenetiche sui *Dixidae* della Sardegna. Atti Assoc. Genet. Ital. Pavia XI: 286–291.

Harbach, R. E. and K. L. Knight. 1980. Taxonomists' Glossary of Mosquito Anatomy. Plexus Publ. Co., Marlton, N.J. 413 pp.

Hennig, W. 1950. Die Larvenformen der Dipteren. Teil 2, pp. 66–67.

Johannsen, O. A. 1903. Aquatic nematocerous Diptera. N.Y. State Mus. Bull. 68: 429–432.

———. 1933. Aquatic Diptera, Part I. Nemosera exclusive of Chironomidae and Ceratopogonidae. Cornell Univ. Agric. Exp. Stn. Mem. 164: 35–37.

Martini, E. 1929. Subfamilie Dixidae. Pp. 20–43. *In* Lindner, E., Die Fliegen der Palaearktischen region Lief 33, Culicidae.

Nowell, W. R. 1951. The dipterous family Dixidae in western North America. Microentomology 16: 187–270.

Peters, T. M. 1981a. Family Dixidae. *In* McAlpine, J. F., B. V. Peterson, G. E. Shewell, H. J. Teskey, J. R. Vockeroth, and D. M. Wood, Manual of Nearctic Diptera. Vol. I. Res. Branch, Agric. Can., Monogr. No. 27. 674 pp.

———. 1981b. A new Nearctic *Dixa* (Diptera:Dixidae). Proc. Entomol. Soc. Wash. 83: 516–519.

Peters, T. M. and P. Barbosa. 1970. A new Nearctic species of Dixinae (Culicidae:Diptera). Entomol. News 81: 11–17.

Peters, T. M. and E. F. Cook. 1966. The Nearctic Dixidae. Misc. Publ. Entomol. Soc. Am. 5: 231–278.

Rohdendorf, B. 1964. The Historical Development of Diptera. Tr. Paleontol. Inst. Akad. Nauk USSR, Vol. 100 (English translation, Univ. of Alberta Press, Edmonton. 360 pp.)

Smith, F. K. 1928. Larval characters of genus *Dixa*. J. N.Y. Entomol. Soc. 36: 263–286.

Tonnoir, A. L. 1921–1923. Australian Dixidae. Pap. Proc. R. Soc. Tasmania, pp. 58–71.

Waters, T. F. 1962. Diurnal periodicity in the drift of stream invertebrates. Ecology 43: 316–320.